

Claims

- [c1] A shell for use in a subsurface borehole, comprising:
a composite body adapted to cover a source or sensor,
providing transparency to the passage of signals to or
from said source or sensor;
wherein the body is adapted with a uniform conductive
surface providing a path to short electric currents near
the source or sensor.
- [c2] The shell of claim 1, wherein the body is adapted to provide transparency to the passage of electromagnetic signals.
- [c3] The shell of claim 2, wherein the body is formed to prevent direct exposure of the source or sensor to fluids within the borehole.
- [c4] The shell of claim 3, wherein the body forms a cylindrical surface of revolution with an inner bore adapted to house the source or sensor.
- [c5] The shell of claim 4, further comprising a conductor coupled to the body to pass electric current through the shell and into said inner bore.

- [c6] The shell of claim 5, wherein the conductor is disposed within the shell.
- [c7] The shell of claim 1, wherein the body comprises a composite graphite material including carbon particles disposed therein.
- [c8] The shell of claim 1, wherein the body comprises a carbon-loaded epoxy mixed with carbon fabric.
- [c9] The shell of claim 1, wherein the body comprises multiple prepreg graphite layers.
- [c10] The shell of claim 1, wherein the body comprises concentric layers of fabric including carbon particles disposed therein.
- [c11] The shell of claim 4, further comprising a second cylindrical surface of revolution disposed within the inner bore of the body in contact with the inner surface of the body, the second surface adapted to provide transparency to the passage of electromagnetic signals.
- [c12] The shell of claim 11, wherein the second surface of revolution comprises an opening along its cylindrical wall providing a channel between its inner bore and the inner surface of the shell body.
- [c13] The shell of claim 1, wherein the body forms a cylindrical

surface of revolution with an inner bore adapted to house the source or sensor.

- [c14] The shell of claim 13, wherein the body comprises a recess formed therein, the recess extending from the inner bore toward the outer surface of the shell.
- [c15] The shell of claim 14, further comprising a conductive element disposed within said recess.
- [c16] The shell of claim 13, the body further comprising a metallic conductor disposed therein.
- [c17] The shell of claim 1, wherein the body is formed of carbon-loaded thermal plastic.
- [c18] An apparatus for use in a subsurface borehole, comprising:
 - an elongated support;
 - an antenna disposed on the support, the antenna adapted to transmit or receive electromagnetic energy;
 - and
 - a composite shell disposed on the support to cover the antenna, the shell providing transparency to the passage of electromagnetic energy;
 - wherein the shell is adapted with a uniform conductive surface providing a path to short electric currents near the antenna.

- [c19] The apparatus of claim 18, wherein the shell forms a sleeve around the elongated support, said sleeve having an inner bore to house the antenna.
- [c20] The apparatus of claim 19, further comprising a conductor coupled to the sleeve to pass electric current through the sleeve and into said inner bore.
- [c21] The apparatus of claim 20, wherein the elongated support consists of a metallic tubular and the conductor coupled to the sleeve to pass electric current is coupled to said tubular.
- [c22] The apparatus of claim 18, wherein the sleeve comprises a composite graphite material including carbon particles disposed therein.
- [c23] The apparatus of claim 18, wherein the sleeve comprises a carbon-loaded epoxy mixed with carbon fabric.
- [c24] The apparatus of claim 18, wherein the sleeve comprises multiple prepreg graphite layers.
- [c25] The apparatus of claim 18, wherein the antenna comprises a plurality of coils having non-parallel axes.
- [c26] The apparatus of claim 18, wherein the antenna is disposed on said tubular such that current shorted near the

antenna passes through the antenna.

- [c27] The apparatus of claim 18, wherein said antenna is disposed on said support with its axis at an angle with respect to the support axis.
- [c28] The apparatus of claim 19, further comprising a second sleeve disposed within the inner bore of the composite sleeve in contact with the inner surface of said sleeve, the second sleeve adapted to provide transparency to the passage of electromagnetic energy.
- [c29] The apparatus of claim 28, wherein the second sleeve comprises an opening along its wall providing a channel between its inner bore and the inner surface of the outer sleeve.
- [c30] The apparatus of claim 19, wherein the sleeve comprises a recess formed therein, the recess extending from the inner bore toward the outer surface of the sleeve.
- [c31] The apparatus of claim 30, further comprising a conductive element disposed within said recess.
- [c32] The apparatus of claim 18, the shell further comprising a metallic conductor disposed therein.
- [c33] The apparatus of claim 18, wherein the sleeve is formed of carbon-loaded thermal plastic.

- [c34] An apparatus for use in a subsurface borehole, comprising:
an antenna adapted to transmit or receive electromagnetic energy;
a composite shell covering the antenna, the shell providing transparency to the passage of electromagnetic energy;
wherein the shell is adapted with a uniform conductive surface providing a path to short electric currents near the antenna; and
a conductor coupled to the shell to pass said electric currents through said shell.
- [c35] The apparatus of claim 34, wherein the shell comprises a composite graphite material including carbon particles disposed therein.
- [c36] The apparatus of claim 34, wherein the shell comprises a carbon-loaded epoxy mixed with carbon fabric.
- [c37] The apparatus of claim 34, wherein the shell comprises multiple prepreg graphite layers.
- [c38] The apparatus of claim 34, wherein the antenna comprises a plurality of coils having non-parallel axes.
- [c39] The apparatus of claim 34, wherein the conductor cou-

pled to the shell to pass said electric currents is adapted to pass the current through the antenna.

- [c40] The apparatus of claim 34, wherein the shell forms a sleeve having an inner bore to house the antenna.
- [c41] The apparatus of claim 40, further comprising a second sleeve disposed within the inner bore of the composite sleeve in contact with the inner surface of said sleeve, the second sleeve adapted to provide transparency to the passage of electromagnetic energy.
- [c42] The apparatus of claim 41, wherein the second sleeve comprises an opening along its wall providing a channel between its inner bore and the inner surface of the outer sleeve.
- [c43] The apparatus of claim 40, wherein the sleeve comprises a recess formed therein, the recess extending from the inner bore toward the outer surface of the sleeve.
- [c44] The apparatus of claim 43, further comprising a conductive element disposed within said recess.
- [c45] The apparatus of claim 34, the shell further comprising a metallic conductor disposed therein.
- [c46] The apparatus of claim 34, wherein the shell is formed of carbon-loaded thermal plastic.

